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A high-resolution imaging X-ray crystal spectrometer for intense laser plasma interaction experiments

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ABSTRACT:

Precision measurements of electron and ion temperatures through X-ray line broadening can provide critical information on plasma evolution and collisional equilibration processes. Better understanding of electron-ion temperature equilibration in laser produced high energy density (HED) plasmas, including inertial confinement fusion implosions and short-pulse laser heated plasmas, is vital to improving the simulation and prediction of these plasmas. Adapting a technique established for magnetic confinement fusion experiments [1], an imaging crystal spectrometer has been designed and tested for HED plasmas. The instrument uses a spherically bent quartz 211 crystal with radius of 490.8 mm. The test was performed using the Titan laser at Lawrence Livermore National Laboratory to irradiate titanium slabs with laser intensities of 10^{19}-10^{20} W/cm^2. He-like and Li-like Ti lines were recorded, from which the spectrometer performance was evaluated. This spectrometer provides very high spectral resolving power (E/dE>7000) while acquiring a one-dimensional image of the source. The characteristics of the spectrometer and some future applications in HED physics are presented.

[1] M. Bitter, *et al.*, *Rev. Sci. Instrum.* **70**, 292 (1999)

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